ABSTRACT

Process Economics Program Report 25D

ADVANCES IN P-XYLENE TECHNOLOGIES

(November 2006)

Global demand for xylene isomers has been steadily increasing, with p-xylene leading the way. p-Xylene is a key raw material for the large polyester fiber industry, which is experiencing global growth rates near 6% per year. Future polyester growth will continue to be driven by the Asia region and, more specifically, by the Chinese market. After a period of severe overcapacity during 1999-2002, global operating rates for p-xylene were above 90% in 2005, and a number of new capacity additions are underway.

The high demand for p-xylene has created incentives for technological advances. Catalyst innovations have significantly improved the processes for on-purpose xylene production, such as toluene disproportionation, transalkylation, and xylene isomerization. A relatively new development is the toluene alkylation process, in which p-xylene is obtained by reacting toluene and methanol with little benzene by-product. In the p-xylene recovery field, adsorptive separation has been the dominant process worldwide, although crystallization technology has attracted renewed interest. In addition to updated configuration and processing schemes, which result in higher unit efficiency, modern crystallization plants use more reliable and larger-scale equipment. New p-xylene crystallization capacity additions have been made in combination with the para-selective toluene disproportionation technology.

The focus of this report is on recent improvements in technologies for p-xylene production and recovery. We also developed conceptual designs and preliminary economics for three configurations of an aromatics complex producing p-xylene and benzene. The main feed streams of the complex are a C_8 aromatics fraction and a BT extract fraction, both derived from catalytic reformate. Each design includes a toluene conversion section, a C_{9+} and o-xylene separation section, a p-xylene recovery section, and an isomerization section. The following process configurations were evaluated:

- Toluene conversion by selective disproportionation and p-xylene recovery by adsorption.
- Toluene conversion by alkylation with methanol and p-xylene recovery by adsorption.
- Toluene conversion by selective disproportionation and p-xylene recovery by crystallization.

For the two plants using selective toluene disproportionation, the crystallization process has slightly better economics than the adsorption process. At current market prices for benzene, the plant using toluene alkylation has the lowest capital cost but the highest production cost among the three design cases. However, since toluene alkylation produces very little benzene by-product, the technology becomes very competitive at low benzene prices.

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CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Concluded)

ILLUSTRATIONS

ILLUSTRATIONS (Concluded)

TABLES

TABLES (Concluded)